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**POLYMERIC MATERIALS
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Elizabeth T. Shinn



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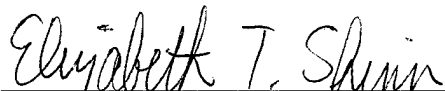
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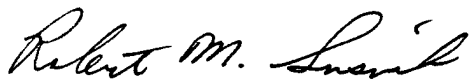
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14. ABSTRACT This final report is a bibliography of technical journal articles, presentations, patents, and reports generated by members of AFRL/MLBP and collaborators. The work was accomplished at Wright-Patterson AFB over a period of 22 years and covers such areas as structural polymers, nonlinear optical polymers, and electrically conductive polymers.					
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Foreword

The following is a compilation of technical journal articles, presentations, patents, and reports generated by members of AFRL/MLBP and collaborators for the period of 1978-2001.



Robert C Evers, Chief
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1978

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1982

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1988

MILESTONE 37: CHOOSE APPROPRIATE GENERIC CHEMICAL STRUCTURES FOR POLYMER SYNTHESIS FOR NLO ACTIVITY.

Although considerable progress has been made in understanding molecular structure/NLO activity relationships, some important data remains to be obtained in order to make a more judicious selection of generic chemical structures for polymer synthesis. While benobisthiazole structures containing thiophene groups show considerable promise, the relationship of NLO activity to polymer molecular weight still needs to be determined and will be addressed in new milestone 41. The present milestone will accordingly be moved to October 1989 to follow completion of milestone 41.

MILESTONE 39: SYNTHESIS OF IMPROVED NLO ORDERED POLYMERS

This milestone will be moved to September 1990 and will follow milestones 37 and 41.

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None

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M. J. Banach, M. D. Alexander, Jr., S. J. Caracci, R. A. Vaia, "Enhancement of Electro-Optic Coefficient of Doped Films Through Optimization of Chromophore Environment," *SPIE Int. Soc. Opt. Eng. Proc.*, **3623**, 120 (1999).

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M. Banach, M. D. Alexander, Jr., S. Caracci and R. A. Vaia, "Enhanced Stability and Order of Guest Molecules in Electro-Optic Polymers," *Chem. Mater.*, accepted for publication (1999).

J. W. Baur, M. D. Alexander, Jr., M. Banach, L. R. Denny, B. A. Reinhardt, P. A. Fleitz, S. M. Kirkpatrick and R. A. Vaia, "Molecular Environment Effects on Two-Photon Absorbing Heterocyclic Chromophores," *Chem. Mater.*, accepted for publication (1999).

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N. Venkatasubramanian, T. D. Dang, D. R. Dean, G. E. Price and F. E. Arnold, "Solvent Cast Thermoplastic and Thermoset Rigid-Rod Molecular Composites," *Polymer*, accepted for publication (1999).

Lectures, Presentations, Talks (*indicates invited presentation):

*M. R. Unroe, "Endcapped Polyarylene Ether Phosphine Oxides For High Temperature Transparencies," Polycondensation '98, Annapolis, MD (September 1998).

*R. A. Vaia, J.-W. Lee and C.-S. Wang, "Electrically Conducting Nanohybrids," Nanoscale Science and Technology, Center for Advanced Photonic and Electronic Materials, State University of New York at Buffalo, Buffalo, NY (October 1998).

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*J. W. Baur, "Electro-Optic Devices From a Beaker," Graduate Materials Engineering Seminar, Department of Engineering, University of Dayton, Dayton, OH (November 1998).

*R. A. Vaia, "Polymeric-Based Conducting Nanohybrids," Corning Inc., Corning, NY (December 1998).

M. J. Banach, M. D. Alexander, Jr., S. J. Caracci and R. A. Vaia, "Enhancement of Electro-Optic Coefficient of Doped Films Through Optimization of Chromophore Environment," Photonics West, SPIE-International Society for Optical Engineering, San Diego, CA (January 1999).

- M. R. Unroe and R. C. Evers, "A Global Salute to Polymers: History of Air Force Sponsored Rigid-Rod Aromatic-Heterocyclic Polymer Development and a Special Salute to PBO," Dayton Section Poster Session, American Chemical Society, Dayton, OH (March 1999).
- M. D. Alexander, Jr. and D. S. Dudis, "Semi-Empirical Calculation of Ionization Potentials for N-Type Conducting and Semiconducting Polymeric Systems," Centennial Meeting, American Physical Society, Atlanta, GA (March 1999).
- M. D. Alexander, R. A. Vaia, D. S. Dudis, C. S. Wang and J. W. Lee, "Characterization of a Novel N-Doped Rigid-Rod Polymer," Centennial Meeting, American Physical Society, Atlanta, GA (March 1999).
- J. W. Baur, M. D. Alexander, Jr., B. A. Reinhardt, R. A. Vaia and R. Kannan, "Relationships Between Chemical Structure and Optical Properties of Two-Photon Absorbing Chromophores," Centennial Meeting, American Physical Society, Atlanta, GA (March 1999).
- B. E. Taylor, C. J. Grayson, G. Du, R. J. Spry, B. A. Reinhardt and J. L. Burkett, "Photovoltaic Studies of Light Emitting Diodes Made From a Nonconjugated Polymer 6FPBO-OD," Centennial Meeting, American Physical Society, Atlanta, GA (March 1999).
- S. Jenkins, K. Jacob, S. Kumar, T. D. Dang and F. E. Arnold, "Effect of Intermolecular Interactions on the Compressive Strength of Rigid-Rod Polymeric Fibers," Centennial Meeting, American Physical Society, Atlanta, GA (March 1999).
- D. M. Lincoln, R. A. Vaia and R. Krishnamoorti, "Influence of Nanoscale Inorganic Layers on the Structure of Semi-Crystalline Polymer," Centennial Meeting, American Physical Society, Atlanta, GA (March 1999).
- B. Sankaran and L.-S. Tan, "Structure-Property Relationships of Bis(ethylenedioxythienyl)naphthalene Systems," 217th National Meeting, American Chemical Society, Anaheim, CA (March 1999).
- M. R. Unroe and R. C. Evers, "History of Air Force-Sponsored Rigid-Rod Aromatic-Heterocyclic Polymer Development: A Salute to PBO," Award Address, ACS Global Salute to Polymers, 217th National Meeting, American Chemical Society, Anaheim, CA (March 1999).
- N. Venkatasubramanian, D. S. Nagvekar, R. A. Vaia, G. E. Price, L.-S. Tan and F. E. Arnold, "Guest-Host Interactions in Organic Dye-Doped Matrix Polymers," 217th National Meeting, American Chemical Society, Anaheim, CA (March 1999).
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M. F. Durstock, "Light Emitting Characteristics and Dielectric Properties of Polyelectrolyte Multilayer Thin Films," Ph.D. Thesis Defense, Massachusetts Institute of Technology, Cambridge, MA (May 1999).

P. T. Mather, D. S. Nagvekar, H. G. Jeon and L.-S. Tan, "Aromatic Thermotropic Polyesters with Controlled Flexibility," International symposium honoring Ronald G. Eby, University of Akron, Akron, OH (May 1999).

*J. W. Baur, "Fundamental Aspects of Polyelectrolyte Multilayer Films," Giviodan-Roure Flavor Company, Cincinnati, OH (June 1999).

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A. D. McFarland, A. V. Fratini and D. S. Dudis, "Polythiophene Dications: Polarons and Bipolarons," *Polym. Prepr.*, **39** (2), 655-656 (1998).

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B. Sankaran and L.-S. Tan, "Structure-Property Relationships of Bis(ethylenedioxythienyl)naphthalene Systems," *Polym. Prepr.*, **40** (1), 189 (1999).

Publications (Submitted):

X. Duan, D. S. Dudis, D. S. Nagvekar, B. Sankaran and L.-S. Tan, "Reduction Potentials of Aromatic-Bis(squarate)s," *Theochem.*, submitted.

G. P. Das and D. S. Dudis, "An *Ab Initio* Model for Solvent Effects in Organic Molecules," *J. Phys. Chem.*, submitted.

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*D. S. Dudis, "Quinoidal/Aromatic Transitions in Conjugated Polymers," University of Toledo, Toledo, OH (November 1998).

*D. Dudis and A. T. Yeates, "The Meaning of the Band-Gap as Approached from Conjugated Polymers," 39th Sanibel Symposium, St. Augustine, FL (February 1999).

G. P. Das and D. S. Dudis, "An *Ab Initio* Model for Solvent Effects in Organic Molecules," 39th Sanibel Symposium, St. Augustine, FL (February 1999).

D. S. Dudis, A. D. McFarland and A. V. Fratini, "Polyene Excited States: An *Ab Initio* CI Investigation of the ¹A_g and ¹B_u Manifolds," 39th Sanibel Symposium, St. Augustine, FL (February 1999).

G. P. Das and D. S. Dudis, "Ab *Initio* Study of Solvent Effects," Centennial Meeting of the American Physical Society, Atlanta, GA (March 1999).

X. Duan and D. S. Dudis, "Structures and Optical Band Gaps of 1,2-Phenylamino Squaraine Polymers" Centennial Meeting of the American Physical Society, Atlanta, GA (March 1999).

X. Duan and D. S. Dudis, "Theoretical Investigation of Electronic Structures and Optical

Band-Gaps for 1,2-Phenylamino Squaraine Polymers," 218th American Chemical Society National Meeting, New Orleans, LA (August 1999).

*D. S. Dudis and A. T. Yeates, "Polymer Ionization Energies and Electron Affinities: Polyacetylene," 218th American Chemical Society National Meeting, New Orleans, LA (August 1999).

*J. S. Wilkes and A. T. Wilkes, "Low-Melting, Mixed Organic-Inorganic Salts as Nonlinear Optical Materials," 218th American Chemical Society National Meeting, New Orleans, LA (August 1999).

Inventions Disclosures and Patents Granted:

None

Professional Activities:

Max Alexander, Jr.	Reviewer for Materials Research Society Session, E. Proceedings, National Meeting (April 1999); Dayton Area Graduate Studies Institute Fellowship Recipient 1998-2000; SEMEDS Volunteer. Reviewer for Journal of Surface and Coatings Technology
D. Dudis	Reviewer for J. Am. Chem. Soc., Inorganica Chimica Acta, Chemistry of Materials, J. Phys. Chem.; Member of PhD Committee (University of Dayton); Chair of ML S&E Computing Advisory Board; Principal Investigator on DoD High Performance Computing Research Project
Robert J. Spry	Adjunct Professor of Physics, Wright State University, Dayton, OH; Wright State University West District Science Day Council and Science Day judge; Reviewer for Applied Physics Letters, Journal of Applied Physics, Journal of Polymer Physics B: Physics Edition, and Journal of the American Chemical Society
Loon-Seng Tan	Reviewer for Macromolecules, Polymer and J. Industrial Chemistry & Engineering

Extended Scientific Visits:

None

APPENDIX B: Off-site Contract and Grant Activities

There were no off-site contracts or grants.

Publications (Refereed):

R. A. Vaia, J. D. Henes and D. S. Dudis, "Chain Conformation and Flexibility of Thorny Rod Polymers," *Polymer*, 39, 6021 (1998).

T. J. Bunning, W. Barnes, P. T. Mather and P. J. Hood, "Mid-Wavelength IR (MWIR) Polarizers from Glassy Cholesteric Liquid Crystals," *Liq. Cryst.*, 26, 557 (1999).

R. A. Vaia, G. P. Price, P. N. Ruth, H. T. Nguyen and J. Lichtenhan, "Polymer/Layered Silicate Nanocomposites as High Performance Ablative Materials," *Appl. Clay Sci.*, 15, 67 (1999).

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None

Publications (Submitted):

P. T. Mather, W. Barnes, P. J. Hood and T. J. Bunning, "Rheo-Optics Studies in the Development of Hybrid MWIR Polarizers," *Mater. Res. Soc. Proc.*, accepted for publication (1999).

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R. A. Vaia and E. P. Giannelis, "Direct Intercalation Between Ordered Media," resubmitted to *Chem. Mater.*, submitted (1999).

R. A. Vaia, D. Lincoln, Z.-G. Wang and B. S. Hsiao, "Mesoscopic Structure in Nanostructured Polymer-Layered Silicate Blends," *Macromolecules*, submitted (1999).

Lectures, Presentations, Talks (*indicates invited presentation):

*P. T. Mather, "Rheo-Optical Investigations of Thermotropic Polymers," University of Michigan, Ann Arbor, MI (October 1998).

*R. A. Vaia, "Polymer-Layered Silicate Nanocomposites," Army Research Laboratory, Aberdeen Proving Grounds, MD (December 1998).

*R. A. Vaia, "Impact of Mesoscopic Structure on the Behavior of Polymer-Inorganic Nanocomposites," University of Wisconsin, Materials Science and Engineering, Madison, WI (February 1999).

*R. A. Vaia, "Polymer/Clay Composites: An Overview of Recent Developments and Applications," Inaugural Address, Dayton/Cincinnati Polymer Research Interest Group, Cincinnati, OH (February 1999).

*R. A. Vaia, "Impact of Mesoscopic Structure on the Behavior of Polymer-Inorganic Nanocomposites," University of Pennsylvania, Materials Science and Engineering, Philadelphia, PA (February 1999).

D. Dean, M. Trimmer and R. A. Vaia, "Physical Aging Behavior of Substituted Poly(p-Phenylenes)," Centennial Meeting, American Physical Society, Atlanta, GA (March 1999).

D. M. Lincoln, R. Krishnamoorti and R. A. Vaia, "Influence of Nanoscale Inorganic Layers on the Structure of Semi-Crystalline Polymers," Centennial Meeting, American Physical Society, Atlanta, GA (March 1999).

P. T. Mather, H. G. Jeon, C. D. Han and D.-O. Kim, "Ordering and Disordering of Thermotropic Polymers in Shear Flow," Centennial Meeting, American Physical Society, Atlanta, GA (March 1999).

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T. J. Bunning, P. T. Mather, W. Barnes and P.J. Hood, "Mid-Wavelength IR (MWIR) Polarizers from Glassy Cholesteric Liquid Crystals," 1999 Spring Meeting, Materials Research Society, San Francisco, CA (April 1999).

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T. S. Haddad, R. S. Stapleton, H. G. Jeon, P. T. Mather, J. D. Lichtenhan and S. Phillips, "Nanostructured Hybrid Organic/Inorganic Materials: Silsesquioxane Modified Plastics," Polym. Prepr., 40, 496 (1999).

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